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(54) Abstract Title
Cyclone apparatus for treating sewage

(57) Invention for processing and treating sewage, whereby drying and elimination of pathogens takes place; comprising a feed assembly with conical section and inlet tube having a discharge area and inlet area for the passage of air and sewage and a rotor for creating reverse vortices in a cyclonic air-stream within the conical section and inlet tube, wherein the invention is configurated to also create a fundamental standing wave - to assist treatment and processing of sewage - and a centripetal boundary envelope inside the conical section.

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SEWAGE PROCESSING TREATMENT INVENTION

This invention relates to an apparatus that treats and processes sewage.

New legislation in many countries is making it increasingly difficult to dispose of sewage into the sea or spread it on land, due to its high content of pathogens. Currently, techniques of drying the sewage, mixed with, for example, lime to combat pathogens, are very expensive. This invention will remove some of the pathogens and dry the sewage at the same time. Market research has shown that the current cost of treatment can be dramatically reduced when using this invention. It will enable sewage companies to substantially reduce transport costs. The end product can also be used in many applications such as fertiliser or to generate electricity.

This novel invention has processed and treated centrifuged sewage containing 21.4% dry solids, at a rate of 4000 Kg per hour, with the expelled powdered product containing 70 to 77% dry solid, and removed at least 25 to 50% of the pathogens, due to the configuration of the invention which creates reverse vortices upstream in front of a rotor which also shears the sewage.

The resulting intense disruption, caused by the action within the reverse vortices in the cyclonic airstream, together with the shearing action of the rotor's blades, will alter the chemical structure of the sewage, for example by turning some of the water in the sewage into hydrogen peroxide. So powerful is the reverse vortex that some of the water in the sewage is separated from the solid, in the form of pure water, and returns back down the wall of the inlet tube whilst sewage is being fed in. High speed video photography has successfully recorded the existence of the reverse vortex. Powder and pure water has been seen coming back down the wall of the inlet tube. (Rocks introduced into the conical section travelled in the opposite direction to the rotor at the same time as particles near the rotor travelled in the same direction of the rotor.) This has imitated what happens inside a tornado. When a tornado hits the ground, the airstream suddenly reverses inside the tornado. (This invention may also disassociate water, create ozone to assist in reducing the smell of the sewage, create N_2, comminute rocks and materials containing oxygen, whilst at the same time producing Abrikosov vortices which aid fusion.)

The apparatus consists of a high speed motor attached to the rotor, a product discharge exit tube area, a specially configurated nine or ten blade rotor rotating horizontally or vertically, contained in a scrolled housing, attached to which is a conical section which slopes downwards at an angle of about 9.7 degrees attached to a feed inlet tube. The inlet tube being parallel and in line with the fan axis. The inlet tube can be mounted horizontally, or vertically with the inlet tube sucking the material upwards due to the high air velocity created by the rotor. Gravity pulling on the sewage will reduce the velocity of the sewage, allowing the reverse vortex further time to treat the sewage.

The 5 to 6mm thick blades, which may be coated to assist with any wear rate problem, lean back 5 degrees from the centre of the hub - whose diameter must not be over 10% of the diameter of the rotor - which also has a specially configurated interrupter attached to it - the height of which must not protrude into the conical section beyond the leading edge of the blade - the blade must not protrude into the conical section more than 14.8% of its maximum width. The feed in tube must have a diameter equal to one-third the diameter of the rotor and the conical section - where it is attached to the housing - must be two-thirds the diameter of the rotor. The scrolled housing

should be as small as possible, for example a clearance of only 10mm widening to 120mm, whilst allowing for the free movement of the rotor which will have a maximum width at its top, equal to 88% of the diameter of the inlet tube. (This rotor width is reduced to only 44% by the time it reaches the hub as its configuration is such that there is a 13 degree angle on one side of the blade and a 45 degree angle on the opposite leading edge side of the blade, which shortens the width of the blade. The angle begins one-third of the length of the blade up from the hub.) The interrupter has two semi-spherical mounds side by side, one having a diameter equal to 42% the diameter of the hub, and the other 21%. Mid-way up, both have a hole drilled in them, from one side to the other, that has a diameter no greater than 10% of the diameter of the hub. The discharge exit tube area will have the same area as the inlet tube diameter. The diameter of the rotor is equal to 41% of the total length of the combined conical section and inlet tube. Therefore a typical rotor diameter of 610mm will have a total feed in length of 1481mm. This 610mm diameter rotor configuration would require a high speed motor, typically 200Kw, that is capable of turning the rotor at a speed of 96 cycles per second (cps) and maintaining that precise speed (to + or - 1 cps) under load. It is essential for the formation of the reverse vortex - and the centripetal boundary envelope within the conical section - that the inlet tube connection to the conical section, and the conical section connection to the housing in front of the rotor, is perfectly smooth to allow a smooth laminar flow. The invention also utilises a feed assembly conveyor system.

To determine the ideal configuration of the invention a formula is used to determine the ideal combined length of the inlet tube and conical section. This is because all parts of the invention are fixed in dimension in relation to the other parts. The simple formula is to divide either the speed (of the rotor, the air, or the passage of material in the air) by the frequency of either the material to be processed or the rotor. This will create a fundamental standing wave down the inlet tube that is specific to the material. When the standing wave is achieved the dimensions of all the parts can then be determined. This standing wave will also assist the treatment and processing, within the boundary envelope, inside the reverse vortex which in turn is situated inside the conical section.

However should the apparatus be built using, for example, a 610mm diameter rotor, the frequency may be such that a different length of feed tube would be required to suit the chosen material. The inlet tube length would then be fixed according to the standing wave created.

CLAIMS

1. Invention for processing and treating sewage comprising a conical section with inlet tube; a rotor for creating reverse vortices upstream in a cyclonic air-stream; the rotor having an inlet for the movement of the air-stream and sewage, and an outlet corridor with exit tube; a feed inlet tube for feeding the sewage into the centripetal boundary envelope, in the conical section, within the reverse vortex for treating and processing the sewage in the conical section and rotor; wherein the wider area of the conical section is 67% the diameter of the rotor.

2. Invention according to claim 1, wherein the wider area of the conical section which is attached to the housing is 67% the diameter of the rotor.

3. Invention according to claim 1 or 2, wherein the area of the inlet of the rotor is 67% the diameter of the rotor.

4. Invention according to any one of the preceding claims, wherein the inlet tube diameter is equal to 34% of the rotor's diameter.

5. Invention according to any one of the preceding claims wherein, the invention further comprises a rotor housing for the rotor, the rotor having 9 or 10 radially extending blades.

6. Invention according to any one of the preceding claims, wherein the length of the conical section and inlet tube is fixed in relation to the entire configuration of the invention.

7. Invention according to any one of the preceding claims, wherein, the invention further comprises a rotor housing for containing the rotor, the rotor having nine or ten radially extending blades, the leading edge of each blade extending not more than 14.8%, of the blades' maximum width, into the conical section.

8. Invention for processing and treating sewage comprising a conical section with inlet tube; a rotor for creating reverse vortices upstream in a cyclonic air-stream within the conical section, the rotor having an inlet and outlet corridor for the passage of the air-stream and sewage; a feed inlet tube for feeding the sewage into the path of the centripetal boundary envelope, in the conical section, within the reverse vortex for treating and processing the sewage within the conical section and rotor, wherein the area on the inlet of the rotor is 67% of the rotor's diameter.

9. Invention according to claim 8, wherein the discharge of the exit tube of the rotor is equal in area to 34% of the rotor's circumferential inlet area.

10. Invention according to claim 8 or 9, wherein the invention further comprises a rotor housing for containing the rotor, the rotor having nine or ten radially extending blades.

11. Invention according to any one of claims 8 to 10, wherein the length of the conical section and inlet tube is fixed in relation to the entire configuration of the invention.

12. Invention according to any one of claims 8 to 11, wherein the invention further comprises a rotor housing for containing the rotor, the rotor having nine or ten radially extending blades, the leading edge of each blade extending not more than 14.8%, of the blades' maximum width, into the conical section.

13. Invention according to any of the preceding claims, wherein the diameter of the inlet of the rotor is 67% of the rotor's diameter.

14. Invention for processing and treating sewage comprising a conical section with inlet tube; a rotor for creating reverse vortices upstream in a cyclonic air-stream within the conical section, the rotor having an inlet and outlet corridor for the passage of the air-stream and sewage; a feed inlet tube for feeding the sewage into the path of the centripetal boundary envelope, in the conical section, within the reverse vortex for treating and processing the sewage within the conical section and rotor, wherein the discharge area of the exit tube of the rotor is equal to 34% of the rotor's circumferential inlet area.

15. Invention according to claim 14, wherein the invention further comprises a rotor housing for containing the rotor, the rotor having 9 or 10 radially extending 5 - 6mm thick blades.

16. Invention according to claim 14 or 15, wherein the length of the conical section and inlet tube is fixed in relation to the entire configuration of the invention.

17. Invention according to any one of the claims 14 to 16, wherein the invention further comprises a rotor housing for containing the rotor, the rotor having nine or ten radially extending blades, the leading edge of each blade extending not more than 14.8%, of the blades' maximum width, into the conical section.

18. Invention according to any one of the preceding claims, wherein the exit of the outlet tube of the rotor is equal to 34% of the rotor's circumferential inlet area.

19. Invention for processing and treating sewage comprising a conical section with inlet tube; a rotor housing for containing a rotor, the rotor housing having an inlet and an outlet; a rotor having nine or ten radially extending blades for creating reverse vortices upstream in a cyclonic air-stream within the conical section via the inlet of the rotor; a feed inlet tube for feeding the sewage into the path of the centripetal boundary envelope within the reverse vortex for treating and processing the sewage within the conical section and rotor.

20. Invention according to claim 19, wherein the length of the conical section and inlet tube is fixed in relation to the entire configuration of the invention.

21. Invention according to claim 19 or 20, wherein the leading edge of each blade of the rotor extends not more than 14.8% of the blades maximum width into the conical section.

22. Invention for treating and processing sewage comprising a conical section with inlet tube; a rotor for creating reverse vortices upstream in a cyclonic air-stream; and a feed inlet tube for feeding the sewage into the centripetal boundary envelope within the reverse

vortex for treating and processing the sewage in the inlet tube, conical section and rotor, wherein the length of the conical section and inlet tube is fixed in relation to the entire configuration of the invention.

23. Invention according to claim 22, wherein the invention further comprises a rotor housing for containing the rotor, the rotor having nine or ten radially extending blades, the leading edge of each blade extending not more than 14.8% of the blades maximum width into the conical section.

24. Invention according to claims 22 or 23, wherein the conical section and inlet tube are of a fixed length in relation to the configuration of the entire invention.

25. Invention for processing and treating sewage comprising a conical section with inlet tube; a rotor housing for containing a rotor, the rotor housing having an inlet and an outlet; a rotor having nine or ten radially extending blades for creating reverse vortices upstream in a cyclonic air-stream within the 9.7 degree sloping conical section via the inlet of the rotor housing; a feed inlet tube for feeding the sewage into the path of the centripetal boundary envelope within the reverse vortex for treating and processing the sewage within the conical section and rotor, wherein the leading edge of each of the blades of the rotor extends not more than 14.8% of the blades maximum width into the conical section.

26. Invention according to any of claims 5,7,10,12,15,17,19 to 21,23 and 25, wherein any part of the invention may be coated with an abrasion resistant material.

27. Invention according to any one of claims 1 to 26, wherein the feed assembly comprises a conveyor that leads to the inlet tube so that sewage may be fed into the path of the air-stream.

28. Invention according to any one of the preceding claims, wherein the distance between the conveyor and the inlet tube may be up to 610mm.

29. A rotor for a sewage processing treatment invention comprising a central hub with nine or ten blades extending radially from the hub for creating reverse vortices upstream in a cyclonic air-stream, the blades extending forwards from the hub of the rotor at an angle of 45 degrees.

30. A rotor according to claim 29 which comprises an interrupter located on the hub.

31. A rotor for treating and processing sewage comprising a central hub; nine or ten blades extending radially from the hub for creating a reverse vortex upstream in front of the rotor, and an interrupter located on the hub.

32. A rotor according to any one of claims 29 to 31, wherein each blade extends radially at an angle of 5 degrees back from the centre of the hub.

33. A rotor according to any one of claims 29 to 32, wherein each blade is concave in

profile and the concavity faces in the direction of rotation of the rotor.

34. A rotor according to claims 30 and 31, wherein the diameter of the interrupter is 90% of the diameter of the hub.

35. A rotor according to any of claims 29 to 34, wherein every part of the invention is coated with an abrasion resistant material.

36. Invention for treating and processing sewage according to any one of claims 1 to 28 in combination with a rotor according to any one of claims 29 to 35.

37. Invention according to any one of the preceding claims, wherein water contained in sewage has its chemical structure altered, for example into hydrogen peroxide.

38. Invention according to any one of the preceding claims, wherein pathogens are removed.

39. Invention according to any one of the preceding claims, wherein water contaminated by sewage is purified.

40. Invention according to any one of the preceding claims, wherein water is disassociated into hydrogen and oxygen.

41. Invention according to any one of the preceding claims, wherein Ozone is created to remove the smell of the sewage.

42. Invention according to any one of the preceding claims, wherein N_2 is created.

43. Invention according to any one of the preceding claims, wherein Abrikosov vortices are formed to aid fusion.

44. Invention according to any of the preceding claims, wherein an inlet tube which is vertical utilises gravity to slow the flow of sewage into the air-stream, thereby enhancing the processing and treatment of material.

45. Invention according to any one of the preceding claims, wherein rocks, or material containing oxygen, are comminuted.

46. Invention according to any one of the preceding claims, wherein the configuration of all its dimensions are related to each other, based on the formula wherein speed is divided by the frequency to create a fundamental standing wave.

47. Invention according to any one of the preceding claims, wherein a rotor diameter of 610mm equates to a rotor speed of 95 to 97 cycles per second.

48. Invention according to any one of the preceding claims, when the conical section and inlet tube is 1481mm; a rotor travelling at 95 to 97 cycles per second for the configuration of reverse vortices will comminute material upstream, in front of the rotor, inside the conical section.

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Claims searched: 1 to 28, 37 to 45, 48 **Date of search:** 10 January 2001

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): C1C

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Other: On-line : WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	EP 0644159 A2 FUJIMOTO et al. Whole document.	
A	EP 0163749 A SULZER. See accompanying abstract.	
A	US 5791066 CREWS. Whole document.	
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A	WPI Abstract Accession No. 1997-237360 & DE 19540488. SCHATZ. See accompanying abstract.	
A	WPI Abstract Accession No. 1995-107884 & DE 4330207. JUENGLING. See accompanying abstract.	

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